

ORDER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

7100.11A

5/22/96

SUBJ: FLIGHT MANAGEMENT SYSTEM PROCEDURES PROGRAM

1. **PURPOSE.** This order provides guidance and standardization for the development and administration of the Flight Management System (FMS) procedures program.

2. **DISTRIBUTION.** This order is distributed to branch level in FAA headquarters and regional Air Traffic, Flight Standards, and Aviation Systems Standards (National Flight Procedures Office (NFPO), AVN-100, and Flight Inspection Operations Division, AVN-200, only), FAA Academy, FAA Technical Center, Flight Inspection Offices (FIO), and all Air Traffic field offices and facilities.

3. **CANCELLATION.** Order 7100.11, Flight Management System Procedures Program, dated April 28, 1994, is cancelled.

4. **BACKGROUND.** Interim FMS procedures were developed at selected airports by Air Traffic, Aviation System Standards, and Flight Standards at the request of, and in cooperation with, the Air Transport Association (ATA), its member airlines and other representatives of the aviation industry to take advantage of onboard computerized avionics and navigational capabilities associated with the more advanced flight management systems. During the development period, the use of FMS procedures was tested at 16 selected airports, and the tests verified that the ability to design procedures and construct routes without the constraints of a single, fixed-navigational aid provides significant flexibility. It is anticipated that there will be a natural evolution and expansion of FMS procedures including the eventual integration of FMS procedures using the Global Positioning System in the navigational solution. In summary, the use of FMS procedures has the potential to provide significant benefits to both users and providers and a standardized program should be expanded nationally.

5. **DEFINITIONS.** Appendix 1 contains a glossary of terms, abbreviations, and acronyms used in this order.

6. **RELATED PUBLICATIONS.** A list of related publications is as follows:

- a. Order 1050.1, Policies and Procedures for Considering Environmental Impacts.
- b. Order 7100.8, Standard Instrument Departure (SID).
- c. Order 7100.9, Standard Terminal Arrival (STAR).
- d. Order 7110.79, Charted Visual Flight Procedures (CVFP).
- e. Order 7400.2, Procedures for Handling Airspace Matters.
- f. Order 8260.3, Terminal Instrument Procedures (TERPS).
- g. Order 8260.19, Flight Procedures and Airspace.
- h. Order 8260.26, Establishing and Scheduling Instrument Approach Procedures Effective Dates.

Distribution: A-W(AT/TA/TO/TR/TX/FS/VN-3 (AVN-100 and 200 only); Initiated By: ATO-120
A-X(AT/FS)-3; A-Y(AY)-3; A-FFS-4(STD); A-FAT-O(STD)

- i. Order 8260.40, Flight Management System (FMS) Instrument Procedures Development.
- j. Notice 7210.360, Noise Screening Procedures for Certain Air Traffic Actions Above 3,000 Feet.
- k. Advisory Circular (AC) 20-129, Airworthiness Approval of Vertical Navigation (VNAV) Systems for use in the U.S. National Airspace System (NAS) and Alaska.
- l. AC 20-130, Airworthiness Approval of Multi-Sensor Navigation Systems for use in the U.S. National Airspace System (NAS) and Alaska.
- m. AC 25-15, Approval of Flight Management Systems in Transport Category Airplanes.
- n. ARINC Specification 424, Navigation System Data Base.
- o. RTCA Document DO-187, Minimum Operational Performance Standards for Airborne Navigation Equipment Using Multi-Sensor Inputs.

7. TYPES OF FMS PROCEDURAL APPLICATIONS.

- a. Emulation of a common air traffic radar vector route.
 - b. Emulation of an existing SID.
 - c. Emulation of an existing STAR.
 - d. Emulation of an existing CVFP.
 - e. Emulation of an existing terminal route.
 - f. FMS SID.
 - g. FMS STAR.
 - h. FMS approach procedure.
 - i. FMS departure procedure.
 - j. Other FMS additions to existing approach procedures.
- (1) Terminal route/initial approach segment with no procedure turn (NO PT) to an existing standard instrument approach procedure (SIAP).
- (2) Missed approach.

8. AIRCRAFT EQUIPMENT REQUIRED FOR FMS PROCEDURES.

- a. There are two levels of FMS equipment capable of flying FMS procedures.
- (1) Slant E (/E). An aircraft equipment suffix denoting that the aircraft has an electronic map, at least dual inertial reference units (IRU), and dual FMS's that meet the requirements of AC's 20-129, 20-130,

and 25-15; ARINC Specification 424; and RTCA DO-187 or equivalent standards as determined by the Flight Standards Service.

(2) Slant F (/F). An aircraft equipment suffix denoting that the aircraft has an FMS that meets the requirements of AC's 20-129, 20-130, and 25-15; ARINC Specification 424; and RTCA DO-187 or equivalent standards as determined by the Flight Standards Service.

b. Normally, procedures will be designed to the slant f (/F) capability and published, "FOR USE BY SLANT E (/E) AND SLANT F (/F) EQUIPPED AIRCRAFT ONLY."

c. When supplemental navigational capability, increased situational awareness, or FMS redundancy are required for safety, availability, integrity, or continuity of function, the procedures will be designed and published, "FOR USE BY SLANT E (/E) EQUIPPED AIRCRAFT ONLY."

Note: The use of aircraft equipment suffixes is for procedural design and charting requirements and for pilot information. It is not the responsibility of ATC to police a pilot's selection of a procedure nor does it relieve the pilot of his/her responsibility to comply with applicable parts of Title 14 of the Code of Federal Regulations.

9. DEVELOPMENT, PROCESSING AND PUBLICATION INSTRUCTIONS.

a. General. Although FMS procedures have the potential to provide benefits to the system users and providers, each request shall be evaluated on an individual basis to determine the appropriate application, if any. Further, requests for FMS procedures, other than emulations, must provide significant benefit to the user/system. The procedures developed in accordance with this order may only be used by aircraft that are authorized to use the slant e and f (/E and /F) equipment suffixes.

b. Emulation of common air traffic radar vector routes and altitudes. It shall be the proponent's responsibility to satisfy the air traffic control (ATC) facility providing radar service that the proponent's aircraft will be reliably navigated to a degree of accuracy that ensures integration with non-FMS aircraft being vectored. The ATC facility shall determine whether a formal letter of agreement is required for these operations.

c. Emulation of existing SID's, STAR's, CVFP's, and terminal routes. If the proponent is an air carrier, that air carrier shall satisfy the certificate holding office that the FMS supplementary form of navigation will not derogate the operator's ability to monitor the navigational aid(s) (NAVAID) used to make up the procedure being emulated or revert to non-FMS methods of navigation. Since the SID's, STAR's, CVFP's, and terminal routes are already published and can be flown by all aircraft that have a navigational data base, no further action is required of Air Traffic, Aviation System Standards, or Flight Standards.

d. FMS SID and STAR. FMS SID's and STAR's shall be developed and processed in accordance with Orders 7100.8, 7100.9, and this order. FMS STAR's shall end at an initial approach fix (IAF) (NO PT) for a SIAP unless it is not practical or would be detrimental to the traffic flow. This does not preclude having a waypoint(s) from which clearance for a visual approach could be initiated when weather and traffic conditions permit.

(1) Forms.

(a) FAA Forms 7100-1, Standard Instrument Departure; 7100-3, SID/STAR Continuation Sheet; 7100-4, Standard Terminal Arrival; and 8260-2, Radio Fix and Holding Data shall be used.

(b) FAA Forms 7100-1, blocks (9) and (10), and 7100-4, blocks (10) and (11) shall have the term "FMS" included in the procedure identification.

(c) The remarks section of FAA Forms 7100-1 and/or 7100-4 shall indicate that "FOR USE BY SLANT E (E) and F (/F) AIRCRAFT ONLY" must be printed on the published plan view of the procedure.

(d) FAA Form 7100-3, SID/STAR Continuation Sheet, shall be used to list the data required in Appendix 2, FMS Data.

(2) Responsibilities.

(a) Proponents. A request for development of an FMS SID or STAR will normally be initiated by a proponent for a specific airport. When the proponent is other than the local ATC facility, the request will be made to the ATC facility providing instrument flight rules (IFR) service to the airport. When the proponent agrees to be the "lead carrier," they will ensure that the proposed procedure is consistent with the design criteria in Appendix 3, Proponent's Guidelines for the Design of FMS Procedures, and flyable, without utilizing maximum performance climbs or descents, by all other FMS-equipped aircraft that are expected to use the procedure. Additionally, the proponent shall provide the affected ATC facility the following:

1 An outline of the type of procedure and expected benefits.

2 After receiving guidance on the traffic flow and ATC operational requirements, provide a proposed ground track, including proposed waypoints and their type (fly-by or fly-over), altitudes, and speed restrictions, or assist in the development of same.

3 If the proponent has the capability, they should be prepared to conduct simulation and/or live testing of the procedure's flyability, if required. The documented results should be provided to the principal operations inspector (POI) for coordination with various FAA offices including the ATC facility for inclusion in the FMS SID or STAR request.

4 Provide assistance in briefing controller personnel on the procedure, if needed.

(b) ATC facility providing IFR service to the airport where the FMS SID or STAR will be used shall:

1 Evaluate the proponent's request and ascertain preliminary feasibility and potential benefits.

2 Provide the proponent with information pertaining to traffic flow and operational constraints; for example, routes, minimum IFR altitudes, facility/sector lateral and vertical airspace boundaries, airspeed restrictions, and a copy of Appendices 2 and 3 to assist them in designing the proposed procedure.

Note: When the proponent is other than an air carrier, the ATC facility should attempt to obtain a "lead carrier" to ensure flyability and assist in the development of the procedure.

3 Coordinate with other ATC facilities that would be affected by the procedure.

4 Act as the focal point for all coordination with the proponent of the FMS procedure, and provide appropriate assistance to the proponent in resolving any problems identified during the development process.

5 Conduct a Notice 7210.360, Noise Screening Procedure for Certain Actions Above 3,000 Feet, to assist the proponent in designing the procedure.

6 Conduct an environmental review in accordance with Order 1050.1 to ensure that the requirements of the National Environmental Policy Act have been met.

Note: The following information is extracted from Order 1050.1: When an FAA action is requested from the public, there may be particular situations such as issuance of various certificates, approval of airline operating specifications or amendments, establishment of new or revised instrument approach/departure procedures affecting noise sensitive areas, etc., which will require the FAA to do an environmental assessment. Whenever this situation occurs, FAA action may be delayed unless assistance in the development of pertinent environmental data is furnished by the applicant or other interested persons.

7 Coordinate with the air route traffic control center (ARTCC) that has IFR jurisdiction for the proposed FMS SID or STAR for compliance and processing in accordance with Orders 7100.8 and 7100.9.

(c) The ARTCC having IFR jurisdiction for the proposed FMS procedure shall complete, with assistance from the proponent, the required forms and submit the proposed FMS SID or STAR to the regional Air Traffic Division (ATD) for review and approval.

(d) ATD.

1 Manage the regional FMS SID and STAR program and serve as the focal point for all coordination with the regional FPO regarding those proposed FMS SID's and STAR's.

2 Review all proposed FMS SID's and STAR's for which they have jurisdiction to ensure accuracy and compliance with the provisions of this order, ensure the airspace will accommodate and contain the procedure, and ensure that the environmental review and analysis are adequate for the proposed action.

3 Forward approved proposals to the regional FPO.

(e) FPO.

1 Review the proposed procedure as outlined in Order 8260.19.

2 Resolve all discrepancies in coordination with the ATD.

3 Forward the proposal to the NFPO for development.

(f) NFPO

1 Review and process the proposal in accordance with Orders 8260.19 and 8260.40.

2 Forward procedures requiring flight inspection to the Flight Inspection Central Operations (FICO).

3 Forward the original and two signed copies of the procedure to the National Flight Data Center (NFDC), Attention: ATA-110.

Note. If there are any discrepancies with the procedure that require resolution, the NFPO should contact the regional FPO and provide recommendations when appropriate. The FPO will be responsible for coordination with the ATD. The ATD will effect the required coordination with the proponent and/or ATC facility.

(g) FIO. Perform flight inspection as required.

Note: At the present time, the FIO's do not have any aircraft that qualify for /E or /F. In order to expedite the processing and publication of the procedure, the FIO may assign a pilot inspector to observe the procedure in the proponent's simulator or in a jumpseat.

e. FMS Approach.

(1) Forms.

(a) FAA Form 8260-5, Nonprecision Instrument Approach Procedure.

(b) FAA Form 7100-3, SID/STAR Continuation Sheet, shall be used to list the data required in Appendix 2.

(2) Responsibilities.

(a) ATC facility.

1 If an FMS approach is required or desired, the proponent will be referred to the regional FPO.

2 Provide assistance and recommendations to facilitate development by providing the proponent and the regional FPO with information pertaining to traffic flow and operational constraints; for example, routes, altitudes, facility/sector lateral and vertical airspace boundaries, airspeed restrictions, and a copy of Appendices 2 and 3 to assist them in designing the proposed procedure.

(b) Proponent. The proponent shall provide the regional FPO with the following:

1 An outline of the type of procedure and expected benefits.

2 After receiving guidance on the traffic flow and air traffic operational requirements, provide the following information:

(aa) Proposed routing, including proposed waypoints and their type (fly-by or fly-over), altitudes, and speed restrictions, or assist in the development of same for all-engine procedure.

Note: If practical, the initial missed approach ground track should be congruent with carrier-designed Federal Aviation Regulation (FAR) 121.189 engine-out procedure.

(bb) Maximum all-engine climb gradient, in feet per nautical mile, that desired aircraft type can achieve.

(cc) Point of contact for operational and performance questions.

3 If the proponent has the capability, they should be prepared to conduct simulation and/or live testing of the procedure's flyability, if required. When the proponent is an ATA member and/or agrees to be the "lead carrier," the proponent will ensure that the proposed procedure is consistent with Appendix 3 and flyable, without utilizing maximum performance climbs or descents, by all other FMS-equipped aircraft expected to use the procedure. The documented results should be given to the regional FPO.

(c) FPO.

- 1 Serve as the regional focal point for all FMS approaches.
- 2 Review the proposed procedure as outlined in Order 8260.19 and determine the practicality and feasibility.
- 3 Resolve all discrepancies in coordination with the regional ATD.
- 4 Forward the proposal to the NFPO for development.

(d) NFPO.

- 1 Develop the procedure in accordance with Order 8260.40.

Note. If there are any discrepancies with the procedure that require resolution, the NFPO should contact the regional FPO and provide recommendations when appropriate. The FPO will be responsible for coordination with the ATD. The ATD will effect the required coordination with the proponent and/or ATC facility.

- 2 Process the proposal in accordance with Order 8260.19.
- 3 Transfer the data from FAA Form 7100-3, SID/STAR Continuation Sheet, to FAA Form 8260-5, Nonprecision Instrument Approach Procedure.
- 4 Forward procedures requiring flight inspection to the FICO.
- 5 Process the procedure for publication.

(e) FIO. Perform flight inspection as required.

Note: At the present time, the FIO's do not have any aircraft that qualify for /E or /F. In order to expedite the processing and publication of the procedure, the FIO may assign a pilot inspector to observe the procedure in the proponent's simulator or in a jumpseat.

f. FMS Departure. There may be situations where there are not enough benefits to the system to develop an FMS SID from an airport. However, a fixed departure route that gives credit for the FMS equipment while providing obstacle clearance may provide significant benefits.

Note: Until charting specifications are available, departures must be either a SID or a Special.

(1) Forms.

- (a) FAA Forms 8260-15, Departure Procedures/Takeoff Minimums.

(b) FAA Form 7100-3, SID/STAR Continuation Sheet, shall be used to list the data required in Appendix 2.

(2) Responsibilities.

(a) ATC facility.

1 If an FMS SID would not provide significant benefits, the proponent will be referred to the regional FPO.

2 Provide assistance and recommendations to facilitate development by providing the proponent and the FPO with information pertaining to traffic flow and operational constraints; for example, routes, altitudes, facility/sector lateral and vertical airspace boundaries, airspeed restrictions, and a copy of Appendices 2 and 3 to assist them in designing the proposed procedure.

(b) Proponent. The proponent shall provide the FPO with the following:

1 An outline of the type of procedure and expected benefits.

2 After receiving guidance on the traffic flow and air traffic operational requirements, provide the following information:

(aa) Proposed routing, including proposed waypoints and their type (fly-by or fly-over), altitudes, and speed restrictions, or assist in the development of same for all-engine procedure.

Note: If practical, the initial ground track of the proposed routing should be congruent with the carrier designed FAR 121.189 engine-out procedure.

(bb) Maximum all-engine climb gradient, in feet per nautical mile, that desired aircraft type can achieve.

(cc) Point of contact for operational and performance questions.

3 If the proponent has the capability, they should be prepared to conduct simulation and/or live testing of the procedure's flyability, if required. When the proponent is an ATA member and/or agrees to be the "lead carrier," the proponent will ensure that the proposed procedure is consistent with Appendix 3 and flyable, without utilizing maximum performance climbs or descents, by all other FMS-equipped aircraft expected to use the procedure. The documented results should be given to the regional FPO.

(c) FPO.

1 Serve as the regional focal point for all FMS departures.

2 Review the proposed procedure as outlined in Order 8260.19.

3 Resolve all discrepancies in coordination with the ATD.

4 Forward the proposal to the NFPO for development.

(d) NFPO.

- 1 Develop the procedure in accordance with Order 8260.40.

Note. If there are any discrepancies with the procedure that require resolution, the NFPO should contact the regional FPO and provide recommendations when appropriate. The FPO will be responsible for coordination with the ATD. The ATD will effect the required coordination with the proponent and/or ATC facility.

- 2 Process the proposal in accordance with Order 8260.19.

3 Transfer the data from FAA Form 7100-3, SID/STAR Continuation Sheet, to FAA Form 8260-10, Standard Instrument Approach Procedure (Continuation Sheet).

- 4 Process the procedure for publication.

g. Other FMS Additions to Existing Approach Procedures.

(1) Terminal route/initial approach segment (NO PT) to an existing SIAP. At those locations where a STAR'S do not end at an IAF for a SIAP, it may be beneficial to develop an FMS terminal route to join the STAR with a SIAP. This would allow those aircraft emulating existing STAR's to continue to use the FMS to fly predetermined routes, altitudes, and airspeeds and join an instrument approach for landing. At other locations, there may be situations where there are not enough benefits to the system to develop an FMS STAR to an airport. However, a fixed route with altitudes to an IAF that would not require a procedure turn may provide significant benefits.

(a) Forms.

- 1 FAA Forms (8260 series) shall be used as appropriate for the procedure.

2 FAA Form 7100-3, SID/STAR Continuation Sheet, shall be used to list the data required in Appendix 2.

(b) Responsibilities.

- 1 ATC facility.

(aa) If a terminal route is needed to connect an existing STAR to an existing SIAP or if an FMS STAR would not provide significant benefits, the proponent will be referred to the regional FPO.

(bb) Provide assistance and recommendations to facilitate development by providing the proponent and the regional FPO with information pertaining to traffic flow and operational constraints; for example, routes, altitudes, facility/sector lateral and vertical airspace boundaries, airspeed restrictions, and a copy of Appendices 2 and 3 to assist them in designing the proposed procedure.

- 2 Proponent. The proponent shall provide the regional FPO with the following:

(aa) An outline of the type of procedure and expected benefits.

(bb) After receiving guidance on the traffic flow and air traffic operational requirements, provide a proposed ground track, including proposed waypoints and their type (fly-by or fly-over), altitudes, and speed restrictions, or assist in the development of same.

(cc) If the proponent has the capability, they should be prepared to conduct simulation and/or live testing of the procedure's flyability, if required. The documented results should be given to the regional FPO. Additionally, when the proponent is a member of the ATA and/or agrees to be the "lead carrier," the proponent will ensure that the proposed procedure is consistent with Appendix 3 and flyable, without utilizing maximum performance climbs or descents, by all other FMS-equipped aircraft expected to use the procedure.

3 FPO.

(aa) Review the proposed procedure as outlined in Order 8260.19.

(bb) Resolve all discrepancies in coordination with the ATD.

(cc) Forward the proposal to the NFPO for development.

4 NFPO.

(aa) Review and process the proposal in accordance with Orders 8260.3, 8260.19, and 8260.40.

(bb) Transfer the data from FAA Form 7100-3, SID/STAR Continuation Sheet, to the appropriate FAA 8260 series forms.

(cc) Forward procedures requiring flight inspection to the FICO.

(dd) Process the procedure for publication after a satisfactory review by the NFPO.

5 FIO. Perform flight inspection as required.

Note: At the present time, the FIO's do not have any aircraft that qualify for /E or /F. In order to expedite the processing and publication of the procedure, the FIO may assign a pilot inspector to observe the procedure in the proponent's simulator or in a jumpseat.

(2) Missed Approach. There may be situations where the use of an FMS missed approach procedure would result in a significant lowering of the decision height (DH), decision altitude height DA(H), or minimum descent altitude (MDA) for the associated approach. Also, an FMS missed approach is a critical element of converging approach procedures. The addition of an FMS missed approach to an existing non-FMS SIAP will require development of a separate procedure. In these cases:

(a) The proponent shall make the request directly to the regional FPO.

1 After receiving guidance on the traffic flow and air traffic operational requirements, provide a proposed ground track, including proposed waypoints and their type (fly-by or fly-over), altitudes, and speed restrictions, or assist in the development of same.

2 FAA Form 7100-3, SID/STAR Continuation Sheet, shall be used to list the data required in Appendix 2.

(b) The FPO shall evaluate the request and, if it is considered feasible, forward the request to the NFPO.

(c) The NFPO shall:

1 Develop the procedure using the criteria in Order 8260.40 and, if appropriate, lower the approach minima accordingly.

Note. If there are any discrepancies with the procedure that require resolution, the NFPO should contact the regional FPO and provide recommendations when appropriate. The FPO will be responsible for coordination with the ATD. The ATD will effect the required coordination with the proponent and/or ATC facility.

2 Transfer the data from FAA Form 7100-3, SID/STAR Continuation Sheet, to the appropriate FAA 8260 series form.

3 Forward completed special procedures to the regional FPO for issuance; or

4 Forward completed SIAP's to NFDC for publication.

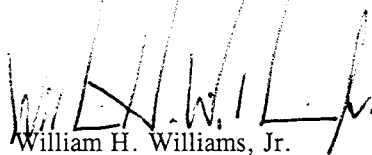
10. Special Terminal Instrument Procedures Developed by Air Carrier Operators.

a. General. Special FMS procedures may be needed to replace a SIAP associated with the scheduled or unscheduled outage of a ground-based NAVAID, to standardize operations, or to provide for contingency planning. Air carriers are authorized to develop and subsequently may obtain approval to use special FMS procedures. These special procedures shall emulate an existing FAA-published SIAP.

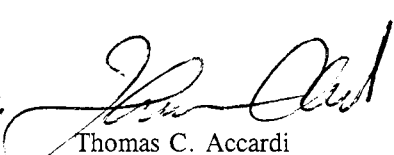
b. The Flight Standards Service, Technical Program Division, AFS-400, shall be responsible for formulating and disseminating policy and guidance for the processing, publication, and use of these special procedures.



C. Roger Wall
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APPENDIX 1. ABBREVIATIONS, TERMS, AND DEFINITIONS

The following abbreviations, terms, and definitions associated with FMS and FMS procedures are used in the basic order and related publications.

CDU. Control and Display Unit

Charted Visual Flight Procedure (CVFP) Approach. An approach wherein a radar-controlled aircraft on an IFR flight plan, operating in VFR conditions and having an ATC authorization, may proceed to the airport of intended landing via visual landmarks and other information depicted on a charted visual flight procedure.

EFIS. Electronic Flight Instrument System

Emulation. The copying, imitating, or duplicating of a procedure. In the case of an FMS emulation, the procedure being emulated (SID, STAR, CVFP, etc.) is developed and stored in the aircraft's FMS navigational data base.

Fly-by Waypoint. A fly-by waypoint requires the use of turn anticipation to avoid overshoot of the next flight segment.

Fly-over Waypoint. A fly-over waypoint precludes any turn until the waypoint is overflown and is followed by an intercept maneuver of the next flight segment.

Flight Management Computer System (FMCS). A computer system that uses a large data base to allow routes to be preprogrammed and fed into the system by means of a data loader. The system is constantly updated with respect to position accuracy by reference to conventional navigational aids. The sophisticated program and its associated data base ensure that the most appropriate aids are automatically selected during the information update cycle.

FMGC. Flight Management Guidance Computer.

Flight Management System (FMS). The FMS is an integration of subsystems which aid the pilot in controlling (managing) the airplane's lateral and vertical path. The primary functions of the FMS are to provide navigation, in-flight performance optimization, and automatic fuel monitoring. The primary controls are the Autopilot Flight Director System Mode Control panel, CDU's, and the EFIS.

FMS Approach. An IFR approach procedure developed exclusively for aircraft authorized to use the slant e or f (/E or /F) aircraft equipment suffixes.

FMS Departure. An IFR departure procedure developed exclusively for aircraft authorized to use the slant e or f (/E or /F) aircraft equipment suffixes.

FMS Procedure. An instrument procedure developed for use by aircraft authorized to use the slant e or f (/E or /F) aircraft equipment suffixes.

FMS SID. A SID developed exclusively for FMS-equipped (slant e or f (/E or /F)) aircraft. (See standard instrument departure).

FMS STAR. A STAR developed exclusively for FMS-equipped (slant e and/or f (/E or /F)) aircraft. (See standard terminal arrival).

FMS Terminal Route. A procedure developed exclusively for FMS-equipped (slant e and/or f (/E or /F)) aircraft to transition from the end of a STAR to an IAF for a SIAP.

Lead Carrier. The lead carrier is an air carrier or operator that has agreed to serve as the focal point for the development of FMS procedures at a specific airport. The lead carrier agrees to help develop the procedure and ensure flyability by all FMS aircraft expected to use the procedure.

Required Navigation Performance (RNP). A statement of the navigational performance accuracy necessary for operation within a defined airspace.

RNP Airspace. A generic term referring to area(s), route(s), or procedure(s) where minimum navigational performance requirements have been established and aircraft must meet that performance while flying in the designated environment.

Runway Update Reference Point. The point where the aircraft shall be positioned and an FMS position update accomplished immediately prior to the initiation of an FMS SID or FMS departure procedure.

Runway Waypoint. A waypoint located on runway centerline at the runway threshold.

Runway Waypoint Elevation. The runway threshold elevation plus 50 feet.

Significant Benefit(s). Tangible or intangible advantages resulting from the implementation of an FMS procedure such as fuel savings from reduced flight tracks and time, reduced inter/intra-facility coordination, reduced communications between ATC and pilots, increased flexibility of airspace management and sectorization due to more finite and predictable ground tracks, or other similar benefits to the users or providers.

SID Transition. A published segment used to connect the basic SID to one of several en route airways/jet routes.

Slant E (/E). An aircraft equipment suffix denoting that the aircraft has an electronic map, at least dual IRU's, and dual FMS's which meet the requirements of Advisory Circulars 20-129, 20-130, and 25-15; ARINC Specification 424; and RTCA DO-187 or equivalent standards as determined by the Flight Standards Service.

Slant F (/F). An aircraft equipment suffix denoting that the aircraft has an FMS that meets the requirements of Advisory Circulars 20-129, 20-130, and 25-15; ARINC Specification 424; and RTCA DO-187 or equivalent standards as determined by the Flight Standards Service.

Standard Instrument Approach Procedure (SIAP). A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or a point from which a landing may be made visually. It is prescribed and approved for a specific airport by competent authority.

Standard Instrument Departure (SID). A preplanned instrument flight rules (IFR) ATC departure procedure published for pilot use in graphic and/or textual form. SID's provide transition from the terminal to the appropriate en route structure.

Standard Terminal Arrival (STAR). A preplanned instrument flight rules (IFR) ATC arrival procedure published for pilot use in graphic and/or textual form. STAR's provide transition from the en route structure to an outer fix, arrival waypoint, or feeder/initial approach fix in the terminal area.

STAR Transition. A published segment used to connect one or more en route airways/jet routes to the basic STAR.

Takeoff Run Available (TORA) The runway length declared available for the ground run on an airplane takeoff.

Takeoff Waypoint (TOWP) A waypoint located on runway centerline at the beginning of the TORA.

Turn Anticipation. The capability of the FMS to determine the point along a course, prior to a fly-by waypoint, where a turn is initiated to provide a smooth path to intercept the succeeding course.

Waypoint. A predetermined geographical position used for route definition and/or progress reporting purposes that is defined by latitude/longitude.

APPENDIX 2. FMS DATA

Instructions for Completing FAA Form 7100-3, SID/STAR Continuation Sheet, on the next page.

BLOCK 1. FMS FIX/NAVAID (OPR: Air Traffic)

Enter the name of the fix in one of the following formats: (1) Five-letter pronounceable name, (2) ARINC-424, or (3) Three-letter facility identification plus facility type; e.g., XYZ VORTAC.

Air Traffic may specify where a name is required due to operational factors.

BLOCK 2. LATITUDE/LONGITUDE (OPR: Proponent)

Enter the latitude and longitude, separated by a "slant (/)," to the nearest hundredth of a second. North latitude and west longitude are assumed unless otherwise indicated. The FIAO's shall verify course and distance information.

BLOCK 3. C (Chart) (OPR: Proponent/Flight Standards Division)

Enter a Y, for yes, if a fix is to be charted. Enter a N, for no, if a fix does not require charting. Any fix where a change in altitude, speed, or direction (heading), including the waypoints where the turn begins and ends, requires charting.

BLOCK 4. FLY-BY/OVER (OPR: Proponent)

Enter a FB to indicate a fly-by waypoint or a FO to indicate a fly-over waypoint. The type will normally be determined by operational or obstacle requirements.

BLOCK 5. LEG TYPE (OPR: Proponent)

Enter the two-letter code for leg type as follows: IF, TF, or RF.

Note: The IF for FMS departures or SID's shall be the takeoff waypoint.

BLOCK 6. TC (true course) (OPR: NFPO)

Enter the true course to the nearest hundredth of a degree. The charting agency will round as necessary for publication.

BLOCK 7. DIST (distance) (OPR: NFPO)

Enter the distance to the nearest hundredth of a nautical mile. The charting agency will round as necessary for publication.

BLOCK 8. ALTITUDE (OPR: Proponent/Air Traffic/NFPO)

Enter the minimum, mandatory, or maximum altitude in 100-foot increments or flight levels in 1,000-foot increments and label each altitude/flight level as "at/above," "at," or "at/below."


BLOCK 9. SPEED (OPR: Proponent/Air Traffic/NFPO)

Enter all minimum, maximum, or mandatory airspeed(s) in KIAS. Optionally, the airspeed may be entered as ground speed (GS). Label each speed restriction "at/above," "at," or "at/below" as appropriate. Following the numerical value, add "K" for KIAS or "G" for ground speed.

Note: The FMS will automatically reduce the airspeed to 250 KIAS when descending below 10,000 feet MSL and it is not necessary to indicate this altitude.

BLOCK 10. REMARKS (OPR: Any applicable office)

Enter any pertinent information that would clarify a data entry; e.g., airspeed restriction is required by air traffic.

 U.S. Department of Transportation Federal Aviation Administration		<input type="checkbox"/> SID - (Standard Instrument Departure) (Continuation) <input type="checkbox"/> STAR - (Standard Terminal Arrival) (Continuation)										1. Bearings, headings, courses and radials are magnetic 2. Distances are in nautical miles 3. Altitudes are minimum altitudes unless otherwise indicated	
Continuation													
FMS FIX/ NAVAID	LATITUDE/LONGITUDE	C	BY/OVER	FLY	LEG	TYPE	TC	DIST	ALTITUDE	SPEED	REMARKS		
Airport Name													
City & State													
Name	Number			Computer Code			Superseded Nr			Dated	Effective Date		

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APPENDIX 3. PROPONENT'S GUIDELINES FOR THE DESIGN OF FMS PROCEDURES

1. **General.** Safety is a primary concern and procedures must be designed so that they can be confidently and consistently flown, without utilizing maximum performance climbs or descents, by all FMS-equipped aircraft that will use the procedure. As a general rule, procedures must permit the aircraft to be stabilized at normal speed and configuration at the final approach fix appropriate for the procedure.

2. **Equipment.** Procedures should be designed to be flown by single-FMS, non-EFIS aircraft such as the B737-300, using current delivered equipment. However, this does not preclude developing procedures that require a higher level of equipment when significant operational benefits can be achieved or equipment redundancy is required to ensure safety.

3. **Charts.** To the maximum extent practical, charted procedures should be identical to what is displayed on CDU's. To this end, procedures should be designed as simple as possible.

4. **Curved path.** In many of today's systems, path construction is segmented, that is, point-to-point using either fly-by or fly-over waypoints. The designer should consider maximum ground speeds when using this construction to approximate a curved path over the ground. (See paragraph 6, Note 1 of this Appendix)

5. **Waypoints.**

a. Fly-by waypoints should be used whenever possible.

b. Fly-over waypoints shall only be used when operationally necessary and for obstacle clearance. Missed approach waypoints shall be flyover except when flyby's are required to ensure separation for specific missed approach procedures at designated airports; e.g., converging but not intersecting runways.

Note: Due to repeatability and path definition problems, fly-over waypoints do not qualify for RNP. When required for environmental or operational reasons, a fly-over waypoint may be used with the understanding that the first segment following the fly-over waypoint would not qualify for required navigation performance (RNP).

c. Procedures should be designed using the fewest number of waypoints.

d. As indicated in Appendix 2, code all waypoints where course, speed, or altitude changes occur and when established for obstacle clearance.

6. **Legs.**

a. In order for the FMS procedures to eventually qualify as RNP type procedures, the following ARINC Standard 424 leg-types should be used:

(1) TF - fixed waypoint to a fixed waypoint

(2) IF - initial fix

(3) RF - constant radius to a fix

b. Refer to ARINC 424 for further details.

c. Use the longest legs possible. The designer must consider speed and course changes when determining minimum leg length. Refer to Order 8260.40 for specific minima.

d. Procedures should be designed using seamless path construction and there should not be any route discontinuities or gaps.

Note 1. A majority of current systems do not support RF legs. For use with systems not supporting RF legs, the procedure designer should use only TF legs with fly-by transitions.

Note 2. Due to repeatability problems, the following leg types are not recommended for use with an RNP procedure; especially, a procedure with a low RNP value: Fix to an Altitude (FA), Direct to a Fix (DF), and Course to a Fix (CF). A DF leg is highly variable and its applicability to the definition of an RNP route is questionable. However, when established on a DF leg, the containment area for that leg can be bounded and the RNP type may be specified relative to the defined path. An FA leg can be tightly contained only in the cross track dimension and it is highly variable in the along track dimension due to the unknown termination point.

Note 3. Due to their nonrepeatability, the following leg types are prohibited from use with an RNP procedure: CA, CD, CI, CR, VA, VD, VI, VM, VR, PI, FC, FD, FM, and AF.

Note 4. When required for environmental or operational reasons, any of the leg types may be used. For example, a departure procedure may require a heading to an altitude to vary the noise along the departure path. In this case, a VA leg would be used from the takeoff waypoint to the requisite altitude and this segment of the procedure would not qualify for RNP.

7. Speed.

a. Use speeds only when necessary to achieve an operational advantage.

b. Procedure criteria designers make assumptions regarding altitude and wind which result in higher procedural altitudes and/or increased segment length. Groundspeed (GS) is the true common denominator and, when used as the basis for speed restrictions, can effectively mitigate or eliminate the penalties incurred by the use of KIAS. The following, by altitude or approach segment, are the KIAS maximums and their GS equivalents:

	<u>KIAS</u>	<u>GS</u>
Initial segment	220	315
Intermediate segment	175	265
Other segments above 10,000 MSL	310	475
Other segments at or below 10,000 MSL	250	350

Note: Refer to Order 8260.40, paragraph 6b(3)(b) for specific examples of groundspeed applications.

8. Altitude.

a. Use as few altitude restrictions as necessary.

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- b. Use hard altitude restrictions only when absolutely necessary.
- c. Use at-or-below, at-or-above, or altitude windows whenever possible.

9. **Climb gradient.** The minimum standard climb gradient is 200 feet per nautical mile (FPNM) to ensure obstacle clearance. In the absence of a specific obstacle, an FMS SID or departure may be designed using a climb gradient of 300 - 500 FPNM. Refer to Order 8260.40 for the exact formula that will be used by the procedures specialist during the obstacle clearance review.

10. **Descent gradient.** Based upon past operational experience, an optimum descent, with a clean airplane and using idle thrust, equates to approximately three degrees (3°) or 318 FPNM. As a general rule, descents from the high altitude en route stratum down to the terminal environment should use the 3° descent gradient. Below 10,000 feet MSL, the maximum descent should be 330 FPNM.

